

FULL SAP CALCULATION PRINTOUT

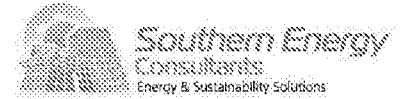
Calculation Type: New Build (As Designed)



Property Reference	SECANG012d				Issued on Date	04/02/2021
Assessment Reference	001	Prop Type Ref	Sem Bri Re Ga Ea			
Property	Hanbury +, Plot 10					
SAP Rating	84 B	DER	0.52	TER	18.93	
Environmental	101 A	% DER<TER	97.25			
CO ₂ Emissions (t/year)	-0.19	DPEE	47.89	TPEE	52.03	
General Requirements Compliance	Pass	% DPEE<TPEE	7.95			
Assessor Details	Mr. Stuart Harvey, Stuart Harvey, [REDACTED]				Assessor ID	T555-0001
Client	Persimon Homes Thames Valley					

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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DWELLING AS DESIGNED

Semi-Detached House, total floor area 70 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.93 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 0.52 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)52.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.9 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.19 (max. 0.25)	0.19 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.34 (max. 2.00)	1.60 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals: 5.00 (design value)
Maximum 10.0 OK

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system:

None

5 Cylinder insulation

Hot water storage No cylinder

6 Controls

Space heating controls: Time and temperature zone control OK

Hot water controls:

No cylinder

Boiler interlock

Yes OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames Valley): Slight OK

Based on:

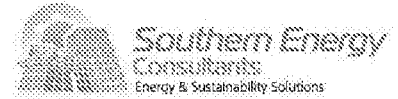
Overshading: Average
Windows facing North East: 4.85 m², No overhang
Windows facing South West: 7.74 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.11 W/m²K
Photovoltaic array 2371.68 kWh/Year

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	35.8800 (1b)	x 2.3100 (2b)	= 82.8828 (1b) - (3b)
First floor	34.2800 (1c)	x 2.5100 (2c)	= 86.0428 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.1600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 168.9256 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1776 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4276 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3635 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4634	0.4543	0.4452	0.3998	0.3907	0.3453	0.3453	0.3362	0.3635	0.3907	0.4089	0.4271 (22b)
Effective ac	0.6074	0.6032	0.5991	0.5799	0.5763	0.5596	0.5596	0.5565	0.5660	0.5763	0.5836	0.5912 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 2 (Uw = 1.30)			12.5900	1.2357	15.5580		(27)
Opening Type 3			2.0600	1.6000	3.2960		(26a)
Heat Loss Floor 1			35.8800	0.1900	6.8172	75.0000	2691.0000 (28a)
Brick/Render Cavity	82.1100	14.6500	67.4600	0.2500	16.8650	60.0000	4047.6000 (29a)
External Roof 1	34.2800		34.2800	0.1100	3.7708	9.0000	308.5200 (30)
Porch Roof	1.9500		1.9500	0.1100	0.2145	9.0000	17.5500 (30)
Total net area of external elements Aum (A, m ²)			154.2200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	46.5215		(33)
Party Wall 1			37.5200	0.0000	0.0000	110.0000	4127.2000 (32)
Internal Wall 1			126.7100			9.0000	1140.3900 (32c)
Internal Wall 2			21.4800			75.0000	1611.0000 (32c)
Internal Floor 1			34.2800			18.0000	617.0400 (32d)
Internal Ceiling 1			34.2800			18.0000	617.0400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	15177.3400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							216.3247 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.9427 (36)
Total fabric heat loss						(33) + (36) =	55.4642 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	33.8582	33.6258	33.3980	32.3279	32.1277	31.1957	31.1957	31.0231	31.5547	32.1277	32.5327	32.9561 (38)
Heat transfer coeff	89.3224	89.0900	88.8622	87.7921	87.5919	86.6599	86.6599	86.4873	87.0189	87.5919	87.9969	88.4203 (39)
Average = Sum(39)m / 12 =												87.7911 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2731	1.2698	1.2666	1.2513	1.2485	1.2352	1.2352	1.2327	1.2403	1.2485	1.2542	1.2603 (40)
HLP (average)												1.2513 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2500 (42)
Average daily hot water use (litres/day)												87.6376 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	96.4013	92.8958	89.3903	85.8848	82.3793	78.8738	78.8738	82.3793	85.8848	89.3903	92.8958	96.4013 (44)
Energy conte	142.9604	125.0341	129.0240	112.4862	107.9332	93.1381	86.3062	99.0376	100.2204	116.7972	127.4933	138.4495 (45)

Regs Region: England

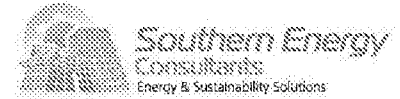
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

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Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1378.8803 (45)
Distribution loss (46)m = 0.15 x (45)m													
	21.4441	18.7551	19.3536	16.8729	16.1900	13.9707	12.9459	14.8556	15.0331	17.5196	19.1240	20.7674	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.0873	12.7040	14.0334	13.5447	13.9700	13.4891	13.9199	13.9524	13.5194	14.0071	13.5970	14.0769	(61)
Total heat required for water heating calculated for each month	157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904	152.5264	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904	152.5264	(64)
Total per year (kWh/year) = Sum(64)m =												1543.7815	(64)
Heat gains from water heating, kWh/month	51.0562	44.7498	46.4088	40.7878	39.3803	34.3407	32.1768	36.4181	36.7031	42.3369	45.7908	49.5537	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.0077	15.9942	13.0074	9.8474	7.3611	6.2145	6.7150	8.7284	11.7153	14.8752	17.3616	18.5082	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	197.6702	199.7214	194.5525	183.5484	169.6577	156.6024	147.8807	145.8295	150.9984	162.0025	175.8932	188.9485	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	(71)
Water heating gains (Table 5)	68.6239	66.5920	62.3774	56.6498	52.9305	47.6954	43.2484	48.9491	50.9766	56.9044	63.5983	66.6044	(72)
Total internal gains	344.0518	342.0577	329.6873	309.7956	289.6993	270.2624	257.5941	263.2570	273.4403	293.5322	316.6032	333.8111	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
Northeast				4.8500	11.2829	0.4400		0.0000		0.7700		18.5399 (75)
Southwest				7.7400	36.7938	0.4400		0.0000		0.7700		96.4849 (79)

Solar gains	115.0248	202.0880	292.8629	390.2887	462.1812	469.8467	448.4014	393.0835	326.3371	227.7607	138.8947	97.7116 (83)
Total gains	459.0766	544.1457	622.5503	700.0843	751.8804	740.1091	705.9955	656.3405	599.7774	521.2928	455.4978	431.5227 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	47.1990	47.3221	47.4435	48.0217	48.1315	48.6491	48.6491	48.7462	48.4484	48.1315	47.9100	47.6805	
alpha	4.1466	4.1548	4.1629	4.2014	4.2088	4.2433	4.2433	4.2497	4.2299	4.2088	4.1940	4.1787	
util living area	0.9948	0.9889	0.9744	0.9332	0.8389	0.6786	0.5211	0.5755	0.8092	0.9568	0.9900	0.9959	(86)
MIT	19.4874	19.6893	20.0021	20.3997	20.7300	20.9228	20.9803	20.9704	20.8307	20.3947	19.8672	19.4532	(87)
Th 2	19.8619	19.8646	19.8671	19.8792	19.8814	19.8920	19.8920	19.8939	19.8879	19.8814	19.8769	19.8721	(88)
util rest of house	0.9932	0.9856	0.9665	0.9119	0.7881	0.5860	0.3989	0.4510	0.7324	0.9387	0.9864	0.9947	(89)
MIT 2	17.8626	18.1577	18.6108	19.1794	19.6146	19.8382	19.8841	19.8807	19.7492	19.1852	18.4266	17.8195	(90)
Living area fraction	18.2014	18.4770	18.9010	19.4339	19.8472	20.0644	20.1126	20.1079	19.9747	19.4374	18.7270	18.1602	(91)
MIT	18.0514	18.3270	18.7510	19.2839	19.6972	19.9144	19.9626	19.9579	19.8247	19.2874	18.5770	18.0102	(92)
Temperature adjustment												-0.1500	
adjusted MIT												18.0102	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9894	0.9790	0.9557	0.8975	0.7784	0.5880	0.4070	0.4587	0.7273	0.9255	0.9802	0.9916	(94)
Useful gains	454.1896	532.7059	594.9871	628.3381	585.2513	435.1972	287.3625	301.0522	436.2055	482.4654	446.4877	427.8925	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1228.3056	1196.2146	1088.6462	911.6239	700.4891	460.5446	291.4066	307.7125	498.1580	760.9470	1009.9366	1221.0985	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	575.9423	445.8778	367.2823	203.9658	85.7369	0.0000	0.0000	0.0000	0.0000	207.1903	405.6832	590.1452	(98)
Space heating												2881.8238	(98)
Space heating per m ²												(98) / (4) =	41.0750 (99)

8c. Space cooling requirement

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3184.3357 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	575.9423	445.8778	367.2823	203.9658	85.7369	0.0000	0.0000	0.0000	0.0000	207.1903	405.6832	590.1452	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	636.4003	492.6827	405.8368	225.3765	94.7369	0.0000	0.0000	0.0000	0.0000	228.9396	448.2687	652.0942	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904	152.5264	(64)
Efficiency of water heater (217)m	89.7948	89.7238	89.5796	89.2506	88.5935	87.3000	87.3000	87.3000	87.3000	89.2342	89.6520	87.3000	(216)
Fuel for water heating, kWh/month	174.8962	153.5135	159.6986	141.2102	137.5983	122.1389	114.8065	129.4272	130.2861	146.5855	157.3756	169.8062	(219)
Water heating fuel used												1737.3430	(219)
Annual totals kWh/year													
Space heating fuel - main system												3184.3357	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												318.0210	(232)
Energy saving/generation technologies (Appendices M,N and Q)													
Total delivered energy for all uses												5314.6996	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

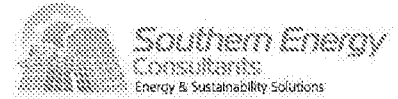
	Energy kWh/year	Emission factor kg CO ₂ /kWh	Emissions kg CO ₂ /year	
Space heating - main system 1	3184.3357	0.2160	687.8165	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1737.3430	0.2160	375.2661	(264)
Space and water heating			1063.0826	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	318.0210	0.5190	165.0529	(268)
Energy saving/generation technologies				
PV Unit	-2371.6800	0.5190	-1230.9019	(269)
Total CO ₂ , kg/year			36.1586	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			0.5200	(273)

16 CO₂ EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		0.5200	ZC1
Total Floor Area	TFA	70.1600	
Assumed number of occupants	N	2.2500	
CO ₂ emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO ₂ emissions from appliances, equation (L14)		16.6954	ZC2
CO ₂ emissions from cooking, equation (L16)		2.4658	ZC3
Total CO ₂ emissions		19.6812	ZC4
Residual CO ₂ emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m ² /year		0.0000	ZC6
Resulting CO ₂ emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO ₂ emissions		19.6812	ZC8

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	35.8800 (1b)	x 2.3100 (2b)	= 82.8828 (1b) - (3b)
First floor	34.2800 (1c)	x 2.5100 (2c)	= 86.0428 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.1600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	168.9256 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1776 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4276 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3635 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4634	0.4543	0.4452	0.3998	0.3907	0.3453	0.3453	0.3362	0.3635	0.3907	0.4089	0.4271 (22b)
Effective ac	0.6074	0.6032	0.5991	0.5799	0.5763	0.5596	0.5596	0.5565	0.5660	0.5763	0.5836	0.5912 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Semi-glazed door			2.0600	1.2000	2.4720		(26a)
TER Opening Type (Uw = 1.40)			12.5900	1.3258	16.6913		(27)
Heat Loss Floor 1			35.8800	0.1300	4.6644		(28a)
Brick/Pender Cavity	82.1100	14.6500	67.4600	0.1800	12.1428		(29a)
External Roof 1	34.2800		34.2800	0.1300	4.4564		(30)
Porch Roof	1.9500		1.9500	0.1300	0.2535		(30)
Total net area of external elements Aum(A, m ²)			154.2200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	40.6804		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.7822 (36)
Total fabric heat loss						(33) + (36) =	50.4626 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	33.8582	33.6258	33.3980	32.3279	32.1277	31.1957	31.1957	31.0231	31.5547	32.1277	32.5327	32.9561 (38)
Heat transfer coeff	84.3208	84.0884	83.8605	82.7905	82.5903	81.6583	81.6583	81.4857	82.0173	82.5903	82.9953	83.4187 (39)
Average = Sum(39)m / 12 =												82.7895 (39)
HLP	1.2018	1.1985	1.1953	1.1800	1.1772	1.1639	1.1639	1.1614	1.1690	1.1772	1.1829	1.1890 (40)
HLP (average)												1.1800 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2500 (42)
Average daily hot water use (litres/day)												87.6376 (43)
Daily hot water use	96.4013	92.8958	89.3903	85.8848	82.3793	78.8738	78.8738	82.3793	85.8848	89.3903	92.8958	96.4013 (44)
Energy conte	142.9604	125.0341	129.0240	112.4862	107.9332	93.1381	86.3062	99.0376	100.2204	116.7972	127.4933	138.4495 (45)
Energy content (annual)										Total = Sum(45)m =		1378.8803 (45)
Distribution loss (46)m = 0.15 x (45)m	21.4441	18.7551	19.3536	16.8729	16.1900	13.9707	12.9459	14.8556	15.0331	17.5196	19.1240	20.7674 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	49.1251	42.7575	45.5523	42.3542	41.9796	38.8967	40.1932	41.9796	42.3542	45.5523	45.8116	49.1251 (61)
Total heat required for water heating calculated for each month	192.0854	167.7916	174.5763	154.8404	149.9128	132.0348	126.4994	141.0172	142.5746	162.3496	173.3050	187.5746 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	192.0854	167.7916	174.5763	154.8404	149.9128	132.0348	126.4994	141.0172	142.5746	162.3496	173.3050	187.5746 (64)
Heat gains from water heating, kWh/month	59.8156	52.2632	54.2885	47.9902	46.3827	40.6926	38.7451	43.4249	43.9118	50.2232	53.8444	58.3157 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.0077	15.9942	13.0074	9.8474	7.3611	6.2145	6.7150	8.7284	11.7153	14.8752	17.3616	18.5082 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	197.6702	199.7214	194.5525	183.5484	169.6577	156.6024	147.8807	145.8295	150.9984	162.0025	175.6932	188.9485 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001 (71)
Water heating gains (Table 5)	80.3973	77.7726	72.9685	66.6531	62.3423	56.5175	52.0768	58.3668	60.9887	67.5043	74.7839	78.3814 (72)
Total internal gains	355.8252	353.2383	340.2784	319.7989	299.1111	279.0845	266.4225	272.6747	283.4524	304.1321	327.7888	345.5880 (73)

6. Solar gains

[Jan]												
					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d	Gains W
Northeast					4.8500	11.2829	0.6300		0.7000		0.7700	16.7238 (75)
Southwest					7.7400	36.7938	0.6300		0.7000		0.7700	87.0338 (79)
Solar gains	103.7576	182.2926	264.1757	352.0582	416.9084	423.8231	404.4784	354.5792	294.3709	205.4505	125.2893	88.1403 (83)
Total gains	459.5828	535.5309	604.4541	671.8571	716.0195	702.9075	670.9009	627.2539	577.8233	509.5825	453.0781	433.7283 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	57.7820	57.9417	58.0991	58.8500	58.9927	59.6660	59.6660	59.7924	59.4048	58.9927	58.7048	58.4068
alpha	4.8521	4.8628	4.8733	4.9233	4.9328	4.9777	4.9777	4.9862	4.9603	4.9328	4.9137	4.8938
util living area	0.9971	0.9933	0.9830	0.9492	0.8592	0.6910	0.5242	0.5782	0.8234	0.9676	0.9938	0.9978 (86)
MIT	19.7403	19.9095	20.1745	20.5153	20.7964	20.9507	20.9898	20.9838	20.8798	20.5126	20.0641	19.7125 (87)
Th 2	19.9185	19.9212	19.9238	19.9360	19.9383	19.9490	19.9490	19.9510	19.9449	19.9383	19.9337	19.9288 (88)
util rest of house	0.9961	0.9911	0.9770	0.9305	0.8096	0.5980	0.4048	0.4560	0.7463	0.9520	0.9913	0.9970 (89)
MIT 2	18.2498	18.4979	18.8832	19.3734	19.7418	19.9168	19.9453	19.9445	19.8508	19.3801	18.7332	18.2164 (90)
Living area fraction	18.5606	18.7923	19.1524	19.6115	19.9617	20.1324	20.1631	20.1612	20.0654	19.6162	19.0107	18.5284 (92)
Temperature adjustment	18.5606	18.7923	19.1524	19.6115	19.9617	20.1324	20.1631	20.1612	20.0654	19.6162	19.0107	18.5284 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	456.9037	528.9269	587.0552	620.3968	580.5494	432.5211	288.3668	302.0142	437.0319	481.9022	447.7152	431.7870 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1202.4637	1168.1774	1061.0405	886.8131	682.3335	451.7681	290.9598	306.4840	489.2623	744.6525	988.5334	1195.2530 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	554.6966	429.5763	352.6451	191.8197	75.7273	0.0000	0.0000	0.0000	0.0000	195.4863	389.3891	568.0187 (98)
Space heating												2757.3591 (98)
Space heating per m ²												(98) / (4) = 39.3010 (99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

9a. Energy requirements - Individual heating systems, including micro-CHP

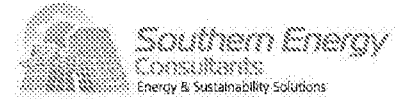
Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												93.4000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												2952.2046 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	554.6966	429.5763	352.6451	191.8197	75.7273	0.0000	0.0000	0.0000	0.0000	195.4863	389.3891	568.0187 (98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000 (210)
Space heating fuel (main heating system)	593.8936	459.9318	377.5643	205.3744	81.0785	0.0000	0.0000	0.0000	0.0000	209.3001	416.9048	608.1570 (211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating requirement	192.0854	167.7916	174.5763	154.8404	149.9128	132.0348	126.4994	141.0172	142.5746	162.3496	173.3050	187.5746 (64)
Efficiency of water heater (217)m	87.5670	87.3152	86.7855	85.5914	83.4283	80.3000	80.3000	80.3000	80.3000	85.5198	87.0286	80.3000 (216)
Fuel for water heating, kWh/month	219.3583	192.1676	201.1583	180.9064	179.6907	164.4269	157.5335	175.6130	177.5524	189.8386	199.1356	87.6628 (217)
Water heating fuel used												2251.3542 (219)
Annual totals kWh/year												2952.2046 (211)
Space heating fuel - main system												0.0000 (215)
Space heating fuel - secondary												
Electricity for pumps and fans:												
central heating pump												30.0000 (230c)
main heating flue fan												45.0000 (230e)
Total electricity for the above, kWh/year												75.0000 (231)
Electricity for lighting (calculated in Appendix L)												318.0210 (232)
Total delivered energy for all uses												5596.5798 (238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2952.2046	0.2160	637.6762 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2251.3542	0.2160	486.2925 (264)
Space and water heating			1123.9687 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	318.0210	0.5190	165.0529 (268)
Total CO2, kg/m2/year			1327.9466 (272)
Emissions per m2 for space and water heating			16.0201 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.3525 (272b)
Emissions per m2 for pumps and fans			0.5548 (272c)
Target Carbon Dioxide Emission Rate (TER) = (16.0201 * 1.00) + 2.3525 + 0.5548, rounded to 2 d.p.			18.9300 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	35.8800 (1b)	x 2.3100 (2b)	= 82.8828 (1b) - (3b)
First floor	34.2800 (1c)	x 2.5100 (2c)	= 86.0428 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.1600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 168.9256 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1776 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4276 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3635 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4634	0.4543	0.4452	0.3998	0.3907	0.3453	0.3453	0.3362	0.3635	0.3907	0.4089	0.4271 (22b)
Effective ac	0.6074	0.6032	0.5991	0.5799	0.5763	0.5596	0.5596	0.5565	0.5660	0.5763	0.5836	0.5912 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 2 (Uw = 1.30)			12.5900	1.2357	15.5580		(27)
Opening Type 3			2.0600	1.6000	3.2960		(26a)
Heat Loss Floor 1			35.8800	0.1900	6.8172	75.0000	2691.0000 (28a)
Brick/Render Cavity	82.1100	14.6500	67.4600	0.2500	16.8650	60.0000	4047.6000 (29a)
External Roof 1	34.2800		34.2800	0.1100	3.7708	9.0000	308.5200 (30)
Porch Roof	1.9500		1.9500	0.1100	0.2145	9.0000	17.5500 (30)
Total net area of external elements Aum (A, m ²)			154.2200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	46.5215		(33)
Party Wall 1			37.5200	0.0000	0.0000	110.0000	4127.2000 (32)
Internal Wall 1			126.7100			9.0000	1140.3900 (32c)
Internal Wall 2			21.4800			75.0000	1611.0000 (32c)
Internal Floor 1			34.2800			18.0000	617.0400 (32d)
Internal Ceiling 1			34.2800			9.0000	308.5200 (32e)
Heat capacity Cm = Sum (A x k)						(28)...(30) + (32) + (32a)...(32e) =	14868.8200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							211.9273 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.9427 (36)
Total fabric heat loss						(33) + (36) =	55.4642 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	33.8582	33.6258	33.3980	32.3279	32.1277	31.1957	31.1957	31.0231	31.5547	32.1277	32.5327	32.9561 (38)
Heat transfer coeff	89.3224	89.0900	88.8622	87.7921	87.5919	86.6599	86.6599	86.4873	87.0189	87.5919	87.9969	88.4203 (39)
Average = Sum(39)m / 12 =												87.7911 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2731	1.2698	1.2666	1.2513	1.2485	1.2352	1.2352	1.2327	1.2403	1.2485	1.2542	1.2603 (40)
HLP (average)												1.2513 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2500 (42)
Average daily hot water use (litres/day)												87.6376 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	96.4013	92.8958	89.3903	85.8848	82.3793	78.8738	78.8738	82.3793	85.8848	89.3903	92.8958	96.4013 (44)
Energy conte	142.9604	125.0341	129.0240	112.4862	107.9332	93.1381	86.3062	99.0376	100.2204	116.7972	127.4933	138.4495 (45)

Regs Region: England

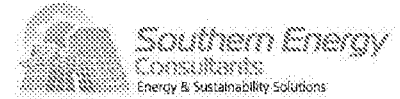
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1378.8803 (45)											
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	30.3791	26.5697	27.4176	23.9033	22.9358	19.7919	18.3401	21.0455	21.2968	24.8194	27.0923	29.4205 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(66)
(66)m	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.0077	15.9942	13.0074	9.8474	7.3611	6.2145	6.7150	8.7284	11.7153	14.8752	17.3616	18.5082	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	197.6702	199.7214	194.5525	183.5484	169.6577	156.6024	147.8807	145.8295	150.9984	162.0025	175.8932	188.9485	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	(71)
Water heating gains (Table 5)	40.8321	39.5383	36.8516	33.1991	30.8277	27.4887	24.6506	28.2870	29.5789	33.3594	37.6282	39.5437	(72)
Total internal gains	313.2600	312.0040	301.1615	283.3449	264.5965	247.0557	235.9963	239.5949	249.0427	266.9872	287.6331	303.7504	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d	Gains W	
Northeast				4.8500	11.2829	0.4400	0.0000			0.7700	18.5399 (75)	
Southwest				7.7400	36.7938	0.4400	0.0000			0.7700	96.4849 (79)	
Solar gains	115.0248	202.0880	292.8629	390.2887	462.1812	469.8467	448.4014	393.0835	326.3371	227.7607	138.8947	97.7116 (83)
Total gains	428.2848	514.0920	594.0244	673.6336	726.7776	716.9023	684.3977	632.6784	575.3798	494.7479	426.5278	401.4620 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	46.2395	46.3602	46.4790	47.0456	47.1531	47.6602	47.6602	47.7553	47.4636	47.1531	46.9361	46.7113
alpha	4.0826	4.0907	4.0986	4.1364	4.1435	4.1773	4.1773	4.1837	4.1642	4.1435	4.1291	4.1141
util living area	0.9956	0.9903	0.9770	0.9385	0.8486	0.6921	0.5346	0.5920	0.8231	0.9619	0.9916	0.9966 (86)
MIT	19.4192	19.6260	19.9477	20.3589	20.7049	20.9126	20.9770	20.9651	20.8106	20.3512	19.8079	19.3852 (87)
Th 2	19.8619	19.8646	19.8671	19.8792	19.8814	19.8920	19.8920	19.8939	19.8879	19.8814	19.8769	19.8721 (88)
util rest of house	0.9943	0.9874	0.9699	0.9187	0.7999	0.6001	0.4105	0.4660	0.7493	0.9458	0.9886	0.9956 (89)
MIT 2	18.4311	18.6386	18.9582	19.3649	19.6796	19.8495	19.8855	19.8829	19.7795	19.3668	18.8301	18.4051 (90)
Living area fraction	18.6372	18.8445	19.1645	19.5722	19.8934	20.0712	20.1131	20.1086	fLA = Living area / (4) =	19.5721	19.0340	0.2085 (91)
MIT	18.6372	18.8445	19.1645	19.5722	19.8934	20.0712	20.1131	20.1086	19.9945	19.5721	19.0340	18.6094 (92)
Temperature adjustment												0.0000
adjusted MIT	18.6372	18.8445	19.1645	19.5722	19.8934	20.0712	20.1131	20.1086	19.9945	19.5721	19.0340	18.6094 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9924	0.9840	0.9642	0.9121	0.8005	0.6162	0.4363	0.4919	0.7575	0.9400	0.9855	0.9941 (94)
Useful gains	425.0151	505.8421	572.7644	614.3927	581.7663	441.7838	298.6217	311.2459	435.8340	465.0622	420.3308	399.0796 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1280.6296	1242.3179	1125.3988	936.9316	717.6788	474.1345	304.4416	320.7475	512.9360	785.8816	1050.1567	1274.0868 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	636.5772	494.9117	411.1600	232.2280	101.1189	0.0000	0.0000	0.0000	0.0000	238.6897	453.4746	651.0054 (98)
Space heating												3219.1655 (98)
Space heating per m2											(98) / (4) =	45.8832 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	814.6030	641.2832	657.3035	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8532	0.9108	0.8858	0.0000	0.0000	0.0000	0.0000 (101)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

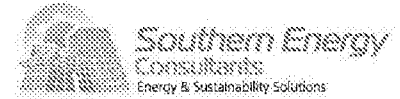


CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	695.0071	584.0759	582.2181	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	921.6814	882.0112	822.9623	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	163.2055	221.6639	179.1137	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fC = cooled area / (4) =			563.9831 (104)
Intermittency factor (Table 10b)												1.0000 (105)
Intermittency factor	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	40.8014	55.4160	44.7784	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												140.9958 (107)
Energy for space heating												2.0096 (108)
Energy for space cooling												45.8832 (99)
Total												2.0096 (108)
Dwelling Fabric Energy Efficiency (DFEE)												47.8928 (109)
												47.9 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	35.8800 (1b)	x 2.3100 (2b)	= 82.8828 (1b) - (3b)
First floor	34.2800 (1c)	x 2.5100 (2c)	= 86.0428 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.1600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 168.9256 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				30.0000 / (5) = 0.1776 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4276 (18)
Number of sides sheltered					2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3635 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4634	0.4543	0.4452	0.3998	0.3907	0.3453	0.3453	0.3362	0.3635	0.3907	0.4089	0.4271 (22b)
Effective ac	0.6074	0.6032	0.5991	0.5799	0.5763	0.5596	0.5596	0.5565	0.5660	0.5763	0.5836	0.5912 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Semi-glazed door			2.0600	1.2000	2.4720		(26a)
TER Opening Type (Uw = 1.40)			12.5900	1.3258	16.6913		(27)
Heat Loss Floor 1			35.8800	0.1300	4.6644		(28a)
Brick/Pender Cavity	82.1100	14.6500	67.4600	0.1800	12.1428		(29a)
External Roof 1	34.2800		34.2800	0.1300	4.4564		(30)
Porch Roof	1.9500		1.9500	0.1300	0.2535		(30)
Total net area of external elements Aum(A, m ²)			154.2200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		40.6804		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.7822 (36)
Total fabric heat loss						(33) + (36) =	50.4626 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	33.8582	33.6258	33.3980	32.3279	32.1277	31.1957	31.1957	31.0231	31.5547	32.1277	32.5327	32.9561 (38)
Heat transfer coeff	84.3208	84.0884	83.8605	82.7905	82.5903	81.6583	81.6583	81.4857	82.0173	82.5903	82.9953	83.4187 (39)
Average = Sum(39)m / 12 =												82.7895 (39)
HLP	1.2018	1.1985	1.1953	1.1800	1.1772	1.1639	1.1639	1.1614	1.1690	1.1772	1.1829	1.1890 (40)
HLP (average)												1.1800 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2500 (42)
Average daily hot water use (litres/day)												87.6376 (43)
Daily hot water use	96.4013	92.8958	89.3903	85.8848	82.3793	78.8738	78.8738	82.3793	85.8848	89.3903	92.8958	96.4013 (44)
Energy conte	142.9604	125.0341	129.0240	112.4862	107.9332	93.1381	86.3062	99.0376	100.2204	116.7972	127.4933	138.4495 (45)
Energy content (annual)										Total = Sum(45)m =		1378.8803 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

Regs Region: England

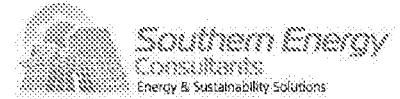
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	30.3791	26.5697	27.4176	23.9033	22.9358	19.7919	18.3401	21.0455	21.2968	24.8194	27.0923	29.4205 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	112.5002	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.0077	15.9942	13.0074	9.8474	7.3611	6.2145	6.7150	8.7284	11.7153	14.8752	17.3616	18.5082	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	197.6702	199.7214	194.5525	183.5484	169.6577	156.6024	147.8807	145.8295	150.9984	162.0025	175.8932	188.9485	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	34.2500	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	(71)
Water heating gains (Table 5)	40.8321	39.5383	36.8516	33.1991	30.8277	27.4887	24.6506	28.2870	29.5789	33.3594	37.6282	39.5437	(72)
Total internal gains	313.2600	312.0040	301.1615	283.3449	264.5965	247.0557	235.9963	239.5949	249.0427	266.9872	287.6331	303.7504	(73)

6. Solar gains

[Jan]													
			Area			Solar flux	g		FF			Access	Gains
			m2			Table 6a	or Table 6b		Specific data	Specific data		factor	W
						W/m2			or Table 6c	or Table 6c		Table 6d	
Northeast			4.8500			11.2829			0.6300	0.7000		0.7700	16.7238 (75)
Southwest			7.7400			36.7938			0.6300	0.7000		0.7700	87.0338 (79)
Solar gains	103.7576	182.2926	264.1757	352.0582	416.9084	423.8231	404.4784	354.5792	294.3709	205.4505	125.2893	88.1403 (83)	
Total gains	417.0176	494.2966	565.3372	635.4031	681.5049	670.8787	640.4748	594.1741	543.4136	472.4377	412.9224	391.8907 (84)	

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	57.7820	57.9417	58.0991	58.8500	58.9927	59.6660	59.6660	59.7924	59.4048	58.9927	58.7048	58.4068	
alpha	4.8521	4.8628	4.8733	4.9233	4.9328	4.9777	4.9777	4.9862	4.9603	4.9328	4.9137	4.8938	
util living area	0.9981	0.9953	0.9870	0.9583	0.8770	0.7149	0.5467	0.6058	0.8486	0.9757	0.9959	0.9986	(86)
MIT	19.6846	19.8564	20.1265	20.4770	20.7730	20.9426	20.9878	20.9802	20.8603	20.4699	20.0121	19.6574	(87)
Th 2	19.9185	19.9212	19.9238	19.9360	19.9383	19.9490	19.9490	19.9510	19.9449	19.9383	19.9337	19.9288	(88)
util rest of house	0.9974	0.9936	0.9823	0.9424	0.8308	0.6220	0.4234	0.4800	0.7761	0.9635	0.9942	0.9981	(89)
MIT 2	18.7237	18.8969	19.1665	19.5168	19.7862	19.9230	19.9460	19.9454	19.8680	19.5173	19.0626	18.7048	(90)
Living area fraction									fLA = Living area / (4) =			0.2085	(91)
MIT	18.9241	19.0970	19.3667	19.7170	19.9919	20.1356	20.1632	20.1612	20.0749	19.7159	19.2606	18.9034	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9241	19.0970	19.3667	19.7170	19.9919	20.1356	20.1632	20.1612	20.0749	19.7159	19.2606	18.9034	(93)

8. Space heating requirement

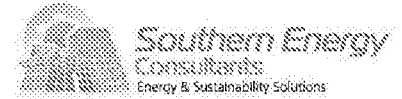
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9966	0.9919	0.9791	0.9383	0.8335	0.6398	0.4494	0.5064	0.7865	0.9601	0.9926	0.9974	(94)
Useful gains	415.5820	490.2957	553.5389	596.1949	568.0112	429.2151	287.8092	300.9086	427.3893	453.5843	409.8859	390.8871	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1233.1134	1193.7999	1079.0080	895.5451	684.8339	452.0262	290.9644	306.4830	490.0464	752.8877	1009.2736	1226.5397	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	608.2433	472.7548	390.9490	215.5322	86.9160	0.0000	0.0000	0.0000	0.0000	222.6817	431.5592	621.7256	(98)
Space heating												3050.3618	(98)
Space heating per m2										(98) / (4) =		43.4772	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	767.5878	604.2712	619.2912	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8794	0.9343	0.9122	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	675.0305	564.5556	564.9044	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	867.8876	830.6727	777.9573	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	138.8571	197.9911	158.5113	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												495.3596	(104)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

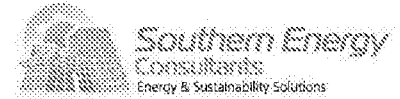


CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction	FC = cooled area / (4) =										1.0000 (105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	34.7143	49.4978	39.6278	0.0000	0.0000	0.0000 (107)
Space cooling											123.8399 (107)
Space cooling per m2											1.7651 (108)
Energy for space heating											43.4772 (99)
Energy for space cooling											1.7651 (108)
Total											45.2423 (109)
Target Fabric Energy Efficiency (TFEE)											52.0 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	35.8800 (1b)	x 2.3100 (2b)	= 82.8828 (1b) - (3b)
First floor	34.2800 (1c)	x 2.5100 (2c)	= 86.0428 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.1600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 168.9256 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1776 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4276 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)]	=	0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20)	=	0.3635 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000 (22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500 (22a)
Adj infilt rate	0.3816	0.3635	0.3635	0.3362	0.3362	0.2998	0.3089	0.2908	0.2998	0.3180	0.3180	0.3453 (22b)
Effective ac	0.5728	0.5660	0.5660	0.5565	0.5565	0.5450	0.5477	0.5423	0.5450	0.5506	0.5506	0.5596 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 2 (Uw = 1.30)			12.5900	1.2357	15.5580		(27)
Opening Type 3			2.0600	1.6000	3.2960		(26a)
Heat Loss Floor 1			35.8800	0.1900	6.8172	75.0000	2691.0000 (28a)
Brick/Render Cavity	82.1100	14.6500	67.4600	0.2500	16.8650	60.0000	4047.6000 (29a)
External Roof 1	34.2800		34.2800	0.1100	3.7708	9.0000	308.5200 (30)
Porch Roof	1.9500		1.9500	0.1100	0.2145	9.0000	17.5500 (30)
Total net area of external elements Aum (A, m ²)			154.2200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.5215		(33)
Party Wall 1			37.5200	0.0000	0.0000	110.0000	4127.2000 (32)
Internal Wall 1			126.7100			9.0000	1140.3900 (32c)
Internal Wall 2			21.4800			75.0000	1611.0000 (32c)
Internal Floor 1			34.2800			18.0000	617.0400 (32d)
Internal Ceiling 1			34.2800			18.0000	617.0400 (32e)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =				15177.3400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							216.3247 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.9427 (36)
Total fabric heat loss			(33) + (36) =				55.4642 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	31.9321	31.5547	31.5547	31.0231	31.0231	30.3788	30.5329	30.2292	30.3788	30.6917	30.6917	31.1957 (38)
Heat transfer coeff	87.3963	87.0189	87.0189	86.4873	86.4873	85.8430	85.9971	85.6934	85.8430	86.1559	86.1559	86.6599 (39)
Average = Sum(39)m / 12 =												86.3964 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2457	1.2403	1.2403	1.2327	1.2327	1.2235	1.2257	1.2214	1.2235	1.2280	1.2280	1.2352 (40)
HLP (average)												1.2314 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2500 (42)
Average daily hot water use (litres/day)												87.6376 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	96.4013	92.8958	89.3903	85.8848	82.3793	78.8738	78.8738	82.3793	85.8848	89.3903	92.8958	96.4013 (44)
Energy conte	142.9604	125.0341	129.0240	112.4862	107.9332	93.1381	86.3062	99.0376	100.2204	116.7972	127.4933	138.4495 (45)

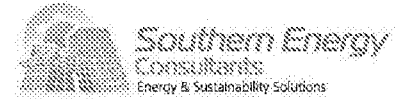
Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design
System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1378.8803 (45)										
Distribution loss (46)m = 0.15 x (45)m											
21.4441	18.7551	19.3536	16.8729	16.1900	13.9707	12.9459	14.8556	15.0331	17.5196	19.1240	20.7674 (46)
Water storage loss:											
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.0873	12.7040	14.0334	13.5447	13.9700	13.4891	13.9199	13.9524	13.5194	14.0071	13.5970 (61)
Total heat required for water heating calculated for each month	157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Solar input (sum of months) = Sum(63)m =											0.0000 (63)
Output from w/h	157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904 (64)
RHI water heating demand											1543.7815 (64)
Heat gains from water heating, kWh/month	51.0562	44.7498	46.4088	40.7878	39.3803	34.3407	32.1768	36.4181	36.7031	42.3369	45.7908 (65)
											1544 (64)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.0192	39.9856	32.5185	24.6186	18.4027	15.5363	16.7875	21.8211	29.2882	37.1881	43.4040	46.2704 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	295.0302	298.0916	290.3768	273.9528	253.2204	233.7349	220.7174	217.6559	225.3708	241.7948	262.5271	282.0126 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001 (71)
Water heating gains (Table 5)	68.6239	66.5920	62.3774	56.6498	52.9305	47.6954	43.2484	48.9491	50.9766	56.9044	63.5983	66.6044 (72)
Total internal gains	507.4233	503.4194	484.0228	453.9712	423.3037	395.7167	379.5034	387.1761	404.3856	434.6374	468.2796	493.6375 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d			Gains W	
Northeast				4.8500	12.9236	0.4400		0.0000	0.7700		21.2357 (75)	
Southwest				7.7400	40.4699	0.4400		0.0000	0.7700		106.1247 (79)	

Solar gains	127.3605	201.7204	289.9885	400.5389	463.9468	505.4625	476.8944	426.2442	351.0490	243.0688	157.6226	107.1084 (83)
Total gains	634.7838	705.1398	774.0113	854.5101	887.2505	901.1792	856.3978	813.4204	755.4347	677.7062	625.9021	600.7459 (84)

7. Mean internal temperature (heating season)

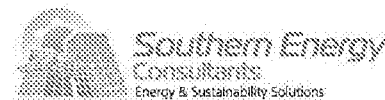
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	48.2392	48.4484	48.4484	48.7462	48.7462	49.1121	49.0240	49.1978	49.1121	48.9337	48.9337	48.6491
alpha	4.2159	4.2299	4.2299	4.2497	4.2497	4.2741	4.2683	4.2799	4.2741	4.2622	4.2622	4.2433
util living area	0.9797	0.9675	0.9356	0.8535	0.6980	0.4656	0.3098	0.3350	0.6165	0.8745	0.9613	0.9831 (86)
MIT	19.8719	20.0323	20.3244	20.6601	20.8930	20.9858	20.9981	20.9974	20.9526	20.6797	20.2356	19.8407 (87)
Th 2	19.8836	19.8879	19.8879	19.8939	19.8939	19.9012	19.8995	19.9029	19.9012	19.8977	19.8977	19.8920 (88)
util rest of house	0.9739	0.9586	0.9175	0.8141	0.6255	0.3682	0.2006	0.2213	0.5165	0.8310	0.9486	0.9783 (89)
MIT 2	18.4335	18.6654	19.0767	19.5299	19.8050	19.8946	19.8992	19.9024	19.8723	19.5699	18.9661	18.3948 (90)
Living area fraction	18.7334	18.9504	19.3368	19.7656	20.0318	20.1221	20.1283	20.1308	20.0976	19.8013	19.2308	18.6963 (92)
MIT	18.5834	18.8004	19.1868	19.6156	19.8818	19.9721	19.9783	19.9808	19.9476	19.6513	19.0808	-0.1500
Temperature adjustment												18.5463 (93)
adjusted MIT												

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	612.3176	667.6581	699.0970	685.8765	554.2466	337.6300	178.5534	186.6118	393.5822	555.2271	585.9155	582.6866 (95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000 (96)
Heat loss rate W	1178.3992	1148.6860	1025.6776	840.2766	595.1912	340.9781	178.7296	186.8777	407.5441	693.6684	954.6754	1165.2536 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	421.1647	323.2508	242.9759	111.1680	30.4628	0.0000	0.0000	0.0000	0.0000	103.0003	265.5071	433.4298 (98)
Space heating												1930.9595 (98)
RHI space heating demand												1931 (98)

FULL SAP CALCULATION PRINTOUT

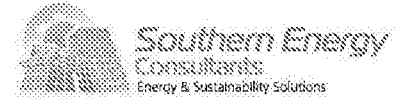
Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	35.8800 (1b)	x 2.3100 (2b)	= 82.8828 (1b) - (3b)
First floor	34.2800 (1c)	x 2.5100 (2c)	= 86.0428 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.1600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 168.9256 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1776 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4276 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3635 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4634	0.4543	0.4452	0.3998	0.3907	0.3453	0.3453	0.3362	0.3635	0.3907	0.4089	0.4271 (22b)
Effective ac	0.6074	0.6032	0.5991	0.5799	0.5763	0.5596	0.5596	0.5565	0.5660	0.5763	0.5836	0.5912 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 2 (Uw = 1.30)			12.5900	1.2357	15.5580		(27)
Opening Type 3			2.0600	1.6000	3.2960		(26a)
Heat Loss Floor 1			35.8800	0.1900	6.8172	75.0000	2691.0000 (28a)
Brick/Render Cavity	82.1100	14.6500	67.4600	0.2500	16.8650	60.0000	4047.6000 (29a)
External Roof 1	34.2800		34.2800	0.1100	3.7708	9.0000	308.5200 (30)
Porch Roof	1.9500		1.9500	0.1100	0.2145	9.0000	17.5500 (30)
Total net area of external elements Aum (A, m ²)			154.2200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	46.5215		(33)
Party Wall 1			37.5200	0.0000	0.0000	110.0000	4127.2000 (32)
Internal Wall 1			126.7100			9.0000	1140.3900 (32c)
Internal Wall 2			21.4800			75.0000	1611.0000 (32c)
Internal Floor 1			34.2800			18.0000	617.0400 (32d)
Internal Ceiling 1			34.2800			18.0000	617.0400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	15177.3400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							216.3247 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.9427 (36)
Total fabric heat loss						(33) + (36) =	55.4642 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	33.8582	33.6258	33.3980	32.3279	32.1277	31.1957	31.1957	31.0231	31.5547	32.1277	32.5327	32.9561 (38)
Heat transfer coeff	89.3224	89.0900	88.8622	87.7921	87.5919	86.6599	86.6599	86.4873	87.0189	87.5919	87.9969	88.4203 (39)
Average = Sum(39)m / 12 =												87.7911 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2731	1.2698	1.2666	1.2513	1.2485	1.2352	1.2352	1.2327	1.2403	1.2485	1.2542	1.2603 (40)
HLP (average)												1.2513 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2500 (42)
Average daily hot water use (litres/day)												87.6376 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	96.4013	92.8958	89.3903	85.8848	82.3793	78.8738	78.8738	82.3793	85.8848	89.3903	92.8958	96.4013 (44)
Energy conte	142.9604	125.0341	129.0240	112.4862	107.9332	93.1381	86.3062	99.0376	100.2204	116.7972	127.4933	138.4495 (45)

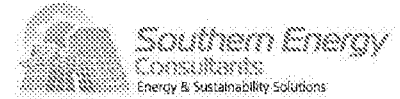
Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design
System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1378.8803 (45)										
Distribution loss (46)m = 0.15 x (45)m											
21.4441	18.7551	19.3536	16.8729	16.1900	13.9707	12.9459	14.8556	15.0331	17.5196	19.1240	20.7674 (46)
Water storage loss:											
Total storage loss											
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage											
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.0873	12.7040	14.0334	13.5447	13.9700	13.4891	13.9199	13.9524	13.5194	14.0071	13.5970 (61)
Total heat required for water heating calculated for each month											
157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904	152.5264 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Solar input (sum of months) = Sum(63)m =	0.0000 (63)										
Output from w/h											
157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904	152.5264 (64)
Heat gains from water heating, kWh/month											
51.0562	44.7498	46.4088	40.7878	39.3803	34.3407	32.1768	36.4181	36.7031	42.3369	45.7908	49.5537 (65)
Total per year (kWh/year) = Sum(64)m =	1543.7815 (64)										

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.0192	39.9856	32.5185	24.6186	18.4027	15.5363	16.7875	21.8211	29.2882	37.1881	43.4040	46.2704	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	295.0302	298.0916	290.3768	273.9528	253.2204	233.7349	220.7174	217.6559	225.3708	241.7948	262.5271	282.0126	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	(71)
Water heating gains (Table 5)	68.6239	66.5920	62.3774	56.6498	52.9305	47.6954	43.2484	48.9491	50.9766	56.9044	63.5983	66.6044	(72)
Total internal gains	507.4233	503.4194	484.0228	453.9712	423.3037	395.7167	379.5034	387.1761	404.3856	434.6374	468.2796	493.6375	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g	Specific data or Table 6b	Specific data or Table 6c	FF			Access factor Table 6d	Gains W
Northeast				4.8500	11.2829		0.4400		0.0000			0.7700	18.5399 (75)
Southwest				7.7400	36.7938		0.4400		0.0000			0.7700	96.4849 (79)

Solar gains	115.0248	202.0880	292.8629	390.2887	462.1812	469.8467	448.4014	393.0835	326.3371	227.7607	138.8947		97.7116 (83)
Total gains	622.4481	705.5074	776.8857	844.2599	885.4848	865.5634	827.9048	780.2597	730.7227	662.3980	607.1743		591.3491 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	47.1990	47.3221	47.4435	48.0217	48.1315	48.6491	48.6491	48.7462	48.4484	48.1315	47.9100	47.6805
alpha	4.1466	4.1548	4.1629	4.2014	4.2088	4.2433	4.2433	4.2497	4.2299	4.2088	4.1940	4.1787
util living area	0.9843	0.9726	0.9479	0.8879	0.7729	0.6022	0.4511	0.4952	0.7222	0.9119	0.9726	0.9871 (86)
MIT	19.7154	19.9059	20.1920	20.5410	20.8068	20.9509	20.9885	20.9831	20.8931	20.5492	20.0720	19.6787 (87)
Th 2	19.8619	19.8646	19.8671	19.8792	19.8814	19.8920	19.8920	19.8939	19.8879	19.8814	19.8769	19.8721 (88)
util rest of house	0.9799	0.9652	0.9335	0.8572	0.7144	0.5124	0.3421	0.3830	0.6375	0.8808	0.9638	0.9835 (89)
MIT 2	18.1922	18.4676	18.8756	19.3628	19.7008	19.8594	19.8876	19.8868	19.8064	19.3876	18.7185	18.1464 (90)
Living area fraction	18.5098	18.7675	19.1501	19.6085	19.9318	20.0870	20.1171	20.1154	20.0330	19.6298	19.0007	18.4659 (91)
MIT	18.3598	18.6175	19.0001	19.4585	19.7818	19.9370	19.9671	19.9654	19.8830	19.4798	18.8507	18.3159 (93)
Temperature adjustment												-0.1500
adjusted MIT												18.3159 (93)

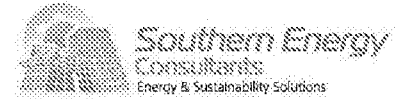
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9718	0.9542	0.9194	0.8435	0.7087	0.5162	0.3497	0.3905	0.6371	0.8668	0.9528	0.9763	(94)
Useful gains	604.8814	673.1814	714.2843	712.1323	627.5005	446.8433	289.5236	304.7248	465.5250	574.1960	578.4950	577.3361	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1255.8571	1222.0920	1110.7871	926.9524	707.9001	462.5031	291.7955	308.3605	503.2301	777.8024	1034.0286	1248.1335	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	484.3259	368.8679	294.9981	154.6704	59.8172	0.0000	0.0000	0.0000	0.0000	151.4832	327.9842	499.0733	(98)
Space heating												2341.2203	(98)
Space heating per m2												(98) / (4) =	33.3697 (99)

8c. Space cooling requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Calculation of Energy Ratings 09 Jan 2014

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000	(201)
Fraction of space heat from main system(s)													1.0000	(202)
Efficiency of main space heating system 1 (in %)													90.5000	(206)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement													2586.9838	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	484.3259	368.8679	294.9981	154.6704	59.8172	0.0000	0.0000	0.0000	0.0000	151.4832	327.9842	499.0733	(98)	
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)	
Space heating fuel (main heating system)	535.1668	407.5889	325.9647	170.9066	66.0964	0.0000	0.0000	0.0000	0.0000	167.3848	362.4135	551.4622	(211)	
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)	
Water heating requirement	157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904	152.5264	(64)	
Efficiency of water heater	89.6949	89.6070	89.4295	89.0347	88.3281	87.3000	87.3000	87.3000	87.3000	88.9885	89.5131	87.3000	(216)	
(217)m	89.6949	89.6070	89.4295	89.0347	88.3281	87.3000	87.3000	87.3000	87.3000	88.9885	89.5131	89.7301	(217)	
Fuel for water heating, kWh/month	175.0909	153.7136	159.9666	141.5525	138.0118	122.1389	114.8065	129.4272	130.2861	146.9902	157.6198	169.9835	(219)	
Water heating fuel used												1739.5878	(219)	
Annual totals kWh/year														
Space heating fuel - main system												2586.9838	(211)	
Space heating fuel - secondary												0.0000	(215)	
Electricity for pumps and fans:														
central heating pump													30.0000	(230c)
main heating flue fan													45.0000	(230e)
Total electricity for the above, kWh/year													75.0000	(231)
Electricity for lighting (calculated in Appendix L)													318.0210	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
Total delivered energy for all uses													4719.5926	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2586.9838	3.4800	90.0270	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1739.5878	3.4800	60.5377	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	318.0210	13.1900	41.9470	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	0.0000	13.1900	0.0000	(252)
Total energy cost			322.4042	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	1.1758	(257)
SAP value		83.5970	
SAP rating (Section 12)		84	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2586.9838	0.2160	558.7885	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1739.5878	0.2160	375.7510	(264)
Space and water heating			934.5395	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	318.0210	0.5190	165.0529	(268)
Energy saving/generation technologies				
PV Unit	-2371.6800	0.5190	-1230.9019	(269)
Total kg/year			-92.3846	(272)
CO2 emissions per m2			-1.3200	(273)
EI value			101.0750	
EI rating			101	(274)
EI band			A	

Calculation of stars for heating and DHW

Main heating energy efficiency $3.48 \times (1 + 0.29 \times 0.00) / 0.9050 = 3.845$, stars = 4

Regs Region: England

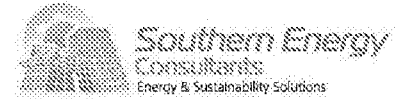
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating environmental impact
Water heating energy efficiency
Water heating environmental impact

$0.216 \times (1 + 0.29 \times 0.00) / 0.9050 = 0.2387$, stars = 4
 $3.48 / 0.8863 = 3.927$, stars = 4
 $0.216 / 0.8863 = 0.2437$, stars = 4

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	35.8800 (1b)	x 2.3100 (2b)	= 82.8828 (1b) - (3b)
First floor	34.2800 (1c)	x 2.5100 (2c)	= 86.0428 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.1600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 168.9256 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1776 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4276 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3635 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000 (22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500 (22a)
Adj infilt rate	0.3816	0.3635	0.3635	0.3362	0.3362	0.2998	0.3089	0.2908	0.2998	0.3180	0.3180	0.3453 (22b)
Effective ac	0.5728	0.5660	0.5660	0.5565	0.5565	0.5450	0.5477	0.5423	0.5450	0.5506	0.5506	0.5596 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 2 (Uw = 1.30)			12.5900	1.2357	15.5580		(27)
Opening Type 3			2.0600	1.6000	3.2960		(26a)
Heat Loss Floor 1			35.8800	0.1900	6.8172	75.0000	2691.0000 (28a)
Brick/Render Cavity	82.1100	14.6500	67.4600	0.2500	16.8650	60.0000	4047.6000 (29a)
External Roof 1	34.2800		34.2800	0.1100	3.7708	9.0000	308.5200 (30)
Porch Roof	1.9500		1.9500	0.1100	0.2145	9.0000	17.5500 (30)
Total net area of external elements Aum (A, m ²)			154.2200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.5215		(33)
Party Wall 1			37.5200	0.0000	0.0000	110.0000	4127.2000 (32)
Internal Wall 1			126.7100			9.0000	1140.3900 (32c)
Internal Wall 2			21.4800			75.0000	1611.0000 (32c)
Internal Floor 1			34.2800			18.0000	617.0400 (32d)
Internal Ceiling 1			34.2800			18.0000	617.0400 (32e)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =				15177.3400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							216.3247 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.9427 (36)
Total fabric heat loss			(33) + (36) =				55.4642 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	31.9321	31.5547	31.5547	31.0231	31.0231	30.3788	30.5329	30.2292	30.3788	30.6917	30.6917	31.1957 (38)
Heat transfer coeff	87.3963	87.0189	87.0189	86.4873	86.4873	85.8430	85.9971	85.6934	85.8430	86.1559	86.1559	86.6599 (39)
Average = Sum(39)m / 12 =												86.3964 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2457	1.2403	1.2403	1.2327	1.2327	1.2235	1.2257	1.2214	1.2235	1.2280	1.2280	1.2352 (40)
HLP (average)												1.2314 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2500 (42)
Average daily hot water use (litres/day)												87.6376 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	96.4013	92.8958	89.3903	85.8848	82.3793	78.8738	78.8738	82.3793	85.8848	89.3903	92.8958	96.4013 (44)
Energy conte	142.9604	125.0341	129.0240	112.4862	107.9332	93.1381	86.3062	99.0376	100.2204	116.7972	127.4933	138.4495 (45)

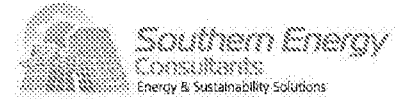
Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design
System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1378.8803 (45)
Distribution loss (46)m = 0.15 x (45)m													
	21.4441	18.7551	19.3536	16.8729	16.1900	13.9707	12.9459	14.8556	15.0331	17.5196	19.1240	20.7674	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.0873	12.7040	14.0334	13.5447	13.9700	13.4891	13.9199	13.9524	13.5194	14.0071	13.5970	14.0769	(61)
Total heat required for water heating calculated for each month	157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904	152.5264	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904	152.5264	(64)
Total per year (kWh/year) = Sum(64)m =												1543.7815	(64)
Heat gains from water heating, kWh/month	51.0562	44.7498	46.4088	40.7878	39.3803	34.3407	32.1768	36.4181	36.7031	42.3369	45.7908	49.5537	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.0192	39.9856	32.5185	24.6186	18.4027	15.5363	16.7875	21.8211	29.2882	37.1881	43.4040	46.2704	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	295.0302	298.0916	290.3768	273.9528	253.2204	233.7349	220.7174	217.6559	225.3708	241.7948	262.5271	282.0126	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	(71)
Water heating gains (Table 5)	68.6239	66.5920	62.3774	56.6498	52.9305	47.6954	43.2484	48.9491	50.9766	56.9044	63.5983	66.6044	(72)
Total internal gains	507.4233	503.4194	484.0228	453.9712	423.3037	395.7167	379.5034	387.1761	404.3856	434.6374	468.2796	493.6375	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d	Gains W
Northeast					4.8500	12.9236	0.4400	0.0000			0.7700	21.2357 (75)
Southwest					7.7400	40.4699	0.4400	0.0000			0.7700	106.1247 (79)

Solar gains	127.3605	201.7204	289.9885	400.5389	463.9468	505.4625	476.8944	426.2442	351.0490	243.0688	157.6226	107.1084 (83)
Total gains	634.7838	705.1398	774.0113	854.5101	887.2505	901.1792	856.3978	813.4204	755.4347	677.7062	625.9021	600.7459 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	48.2392	48.4484	48.4484	48.7462	48.7462	49.1121	49.0240	49.1978	49.1121	48.9337	48.9337	48.6491	
alpha	4.2159	4.2299	4.2299	4.2497	4.2497	4.2741	4.2683	4.2799	4.2741	4.2622	4.2622	4.2433	
util living area	0.9797	0.9675	0.9356	0.8535	0.6980	0.4656	0.3098	0.3350	0.6165	0.8745	0.9613	0.9831	(86)
MIT	19.8719	20.0323	20.3244	20.6601	20.8930	20.9858	20.9981	20.9974	20.9526	20.6797	20.2356	19.8407	(87)
Th 2	19.8836	19.8879	19.8879	19.8939	19.8939	19.9012	19.8995	19.9029	19.9012	19.8977	19.8977	19.8920	(88)
util rest of house	0.9739	0.9586	0.9175	0.8141	0.6255	0.3682	0.2006	0.2213	0.5165	0.8310	0.9486	0.9783	(89)
MIT 2	18.4335	18.6654	19.0767	19.5299	19.8050	19.8946	19.8992	19.9024	19.8723	19.5699	18.9661	18.3948	(90)
Living area fraction	18.7334	18.9504	19.3368	19.7656	20.0318	20.1221	20.1283	20.1308	20.0976	19.6013	19.2308	18.6963	(91)
MIT	18.7334	18.9504	19.3368	19.7656	20.0318	20.1221	20.1283	20.1308	20.0976	19.6013	19.2308	18.6963	(92)
Temperature adjustment	18.5834	18.8004	19.1868	19.6156	19.8818	19.9721	19.9783	19.9808	19.9476	19.6513	19.0808	18.5463	(93)

8. Space heating requirement

Utilisation	0.9646	0.9468	0.9032	0.8027	0.6247	0.3747	0.2085	0.2294	0.5210	0.8193	0.9361	0.9699	(94)
Useful gains	612.3176	667.6581	699.0970	685.8765	554.2466	337.6300	178.5534	186.6118	393.5822	555.2271	585.9155	582.6866	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1178.3992	1148.6860	1025.6776	840.2766	595.1912	340.9781	178.7296	186.8777	407.5441	693.6684	954.6754	1165.2536	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	421.1647	323.2508	242.9759	111.1680	30.4628	0.0000	0.0000	0.0000	0.0000	103.0003	265.5071	433.4298	(98)
Space heating												1930.9595	(98)
Space heating per m ²												(98) / (4) =	27.5222 (99)

8c. Space cooling requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Calculation of EPC Costs, Emissions and Primary Energy 09 Jan 2014

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000	(201)
Fraction of space heat from main system(s)													1.0000	(202)
Efficiency of main space heating system 1 (in %)													90.5000	(206)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement													2133.6569	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	421.1647	323.2508	242.9759	111.1680	30.4628	0.0000	0.0000	0.0000	0.0000	103.0003	265.5071	433.4298	(98)	
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)	
Space heating fuel (main heating system)	465.3753	357.1832	268.4817	122.8376	33.6606	0.0000	0.0000	0.0000	0.0000	113.8125	293.3780	478.9280	(211)	
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)	
Water heating requirement	157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904	152.5264	(64)	
Efficiency of water heater	89.6079	89.5196	89.2871	88.7711	87.9216	87.3000	87.3000	87.3000	87.3000	88.6814	89.3633	87.3000	(216)	
(217)m	89.6079	89.5196	89.2871	88.7711	87.9216	87.3000	87.3000	87.3000	87.3000	88.6814	89.3633	89.6447	(217)	
Fuel for water heating, kWh/month	175.2611	153.8637	160.2216	141.9729	138.6499	122.1389	114.8065	129.4272	130.2861	147.4992	157.8839	170.1455	(219)	
Water heating fuel used	175.2611	153.8637	160.2216	141.9729	138.6499	122.1389	114.8065	129.4272	130.2861	147.4992	157.8839	1742.1567	(219)	
Annual totals kWh/year														
Space heating fuel - main system												2133.6569	(211)	
Space heating fuel - secondary												0.0000	(215)	
Electricity for pumps and fans:														
central heating pump												30.0000	(230c)	
main heating flue fan												45.0000	(230e)	
Total electricity for the above, kWh/year												75.0000	(231)	
Electricity for lighting (calculated in Appendix L)												318.0210	(232)	
Energy saving/generation technologies (Appendices M ,N and Q)														
Total delivered energy for all uses												4268.8346	(238)	

10a. Fuel costs - using BEDF prices (470)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2133.6569	3.8700	82.5725	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1742.1567	3.8700	67.4215	(247)
Pumps and fans for heating	75.0000	18.9000	14.1750	(249)
Energy for lighting	318.0210	18.9000	60.1060	(250)
Additional standing charges			93.0000	(251)
Energy saving/generation technologies				
PV Unit	0.0000	18.9000	0.0000	(252)
Total energy cost			317.2750	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2133.6569	0.2160	460.8699	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1742.1567	0.2160	376.3058	(264)
Space and water heating			837.1757	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	318.0210	0.5190	165.0529	(268)
Energy saving/generation technologies				
PV Unit	-2371.6800	0.5190	-1230.9019	(269)
Total kg/year			-189.7483	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2133.6569	1.2200	2603.0614	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1742.1567	1.2200	2125.4312	(264)
Space and water heating			4728.4926	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	318.0210	3.0700	976.3245	(268)
Energy saving/generation technologies				
PV Unit	-2371.6800	3.0700	-7281.0576	(269)
Primary energy kWh/year			-1345.9905	(272)
Primary energy kWh/m2/year			-19.1846	(273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 84
Current environmental impact rating: A 101

(For testing purposes):	
A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.3	-£ 27	-175 kg (92.3%)

	Typical annual savings	Energy efficiency	Environmental impact
Recommended measures			
Solar water heating	£27	2.50 kg/m²	B 85 A 103
Total Savings	£27	2.50 kg/m²	

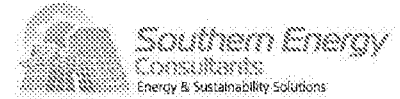
Potential energy efficiency rating: B 85
Potential environmental impact rating: A 103

Fuel prices for cost data on this page from database revision number 470 TEST (21 Dec 2020)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):			
	Current	Potential	Saving
Electricity	£74	£84	-£9
Mains gas	£243	£207	£36
Space heating	£190	£190	£0
Water heating	£67	£41	£27
Lighting	£60	£60	£0
Total cost of fuels	£317	£291	£27
Total cost of uses	£317	£291	£27
Delivered energy	61 kWh/m²	48 kWh/m²	13 kWh/m²
Carbon dioxide emissions	-0.2 tonnes	-0.4 tonnes	0.2 tonnes
CO2 emissions per m²	-3 kg/m²	-5 kg/m²	2 kg/m²
Primary energy	-19 kWh/m²	-33 kWh/m²	14 kWh/m²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
 CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	35.8800 (1b)	x 2.3100 (2b)	= 82.8828 (1b) - (3b)
First floor	34.2800 (1c)	x 2.5100 (2c)	= 86.0428 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.1600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 168.9256 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1776 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4276 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3635 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4634	0.4543	0.4452	0.3998	0.3907	0.3453	0.3453	0.3362	0.3635	0.3907	0.4089	0.4271 (22b)
Effective ac	0.6074	0.6032	0.5991	0.5799	0.5763	0.5596	0.5596	0.5565	0.5660	0.5763	0.5836	0.5912 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 2 (Uw = 1.30)			12.5900	1.2357	15.5580		(27)
Opening Type 3			2.0600	1.6000	3.2960		(26a)
Heat Loss Floor 1			35.8800	0.1900	6.8172	75.0000	2691.0000 (28a)
Brick/Render Cavity	82.1100	14.6500	67.4600	0.2500	16.8650	60.0000	4047.6000 (29a)
External Roof 1	34.2800		34.2800	0.1100	3.7708	9.0000	308.5200 (30)
Porch Roof	1.9500		1.9500	0.1100	0.2145	9.0000	17.5500 (30)
Total net area of external elements Aum (A, m ²)			154.2200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	46.5215		(33)
Party Wall 1			37.5200	0.0000	0.0000	110.0000	4127.2000 (32)
Internal Wall 1			126.7100			9.0000	1140.3900 (32c)
Internal Wall 2			21.4800			75.0000	1611.0000 (32c)
Internal Floor 1			34.2800			18.0000	617.0400 (32d)
Internal Ceiling 1			34.2800			18.0000	617.0400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	15177.3400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							216.3247 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.9427 (36)
Total fabric heat loss						(33) + (36) =	55.4642 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	33.8582	33.6258	33.3980	32.3279	32.1277	31.1957	31.1957	31.0231	31.5547	32.1277	32.5327	32.9561 (38)
Heat transfer coeff	89.3224	89.0900	88.8622	87.7921	87.5919	86.6599	86.6599	86.4873	87.0189	87.5919	87.9969	88.4203 (39)
Average = Sum(39)m / 12 =												87.7911 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2731	1.2698	1.2666	1.2513	1.2485	1.2352	1.2352	1.2327	1.2403	1.2485	1.2542	1.2603 (40)
HLP (average)												1.2513 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2500 (42)
Average daily hot water use (litres/day)												87.6376 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	96.4013	92.8958	89.3903	85.8848	82.3793	78.8738	78.8738	82.3793	85.8848	89.3903	92.8958	96.4013 (44)
Energy conte	142.9604	125.0341	129.0240	112.4862	107.9332	93.1381	86.3062	99.0376	100.2204	116.7972	127.4933	138.4495 (45)

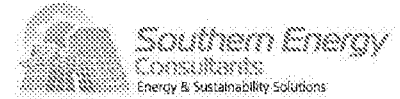
Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design
System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1378.8803 (45)
Distribution loss (46)m = 0.15 x (45)m													
	21.4441	18.7551	19.3536	16.8729	16.1900	13.9707	12.9459	14.8556	15.0331	17.5196	19.1240	20.7674 (46)	
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)	
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)	
Combi loss	14.0873	12.7040	14.0334	13.5447	13.9700	13.4891	13.9199	13.9524	13.5194	14.0071	13.5970	14.0769 (61)	
Total heat required for water heating calculated for each month	157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904	152.5264 (62)	
Aperture area of solar collector												3.0000 (H1)	
Zero-loss collector efficiency												0.7000 (H2)	
Collector heat loss coefficient												1.8000 (H3)	
Collector 2nd order heat loss coefficient												0.0050 (H3a)	
Collector effective heat loss coefficient												1.8063 (H3b)	
Collector performance ratio												2.5804 (H4)	
Annual solar radiation per m2												1079.5246 (H5)	
Overshading factor												0.8000 (H6)	
Solar energy available												1813.6014 (H7)	
Adjustment factor for showers												1.0000 (H7a)	
Solar-to-load ratio												1.3153 (H8)	
Utilisation factor												0.5325 (H9)	
Collector performance factor												0.8793 (H10)	
Dedicated solar storage volume												75.0000 (H11)	
Effective solar volume												75.0000 (H13)	
Daily hot water demand												87.6376 (H14)	
Volume ratio Veff/V												0.8558 (H15)	
Solar storage volume factor												0.9689 (H16)	
Solar input												-822.6836 (H17)	
Solar input	-23.8562	-39.8091	-67.7995	-90.8647	-112.2556	-110.3652	-108.9067	-95.1523	-74.5233	-50.8907	-28.2969	-19.9636 (63)	
	Solar input (sum of months) = Sum(63)m =											-822.6836 (63)	
Output from w/h	133.1915	97.9290	75.2578	35.1662	9.6475	0.0000	0.0000	17.8377	39.2165	79.9137	112.7935	132.5628 (64)	
	Total per year (kWh/year) = Sum(64)m =											733.5163 (64)	
Heat gains from water heating, kWh/month	51.0562	44.7498	46.4088	40.7878	39.3803	34.3407	32.1768	36.4181	36.7031	42.3369	45.7908	49.5537 (65)	

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.0192	39.9856	32.5185	24.6186	18.4027	15.5363	16.7875	21.8211	29.2882	37.1881	43.4040	46.2704	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	295.0302	298.0916	290.3768	273.9528	253.2204	233.7349	220.7174	217.6559	225.3708	241.7948	262.5271	282.0126	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	(71)
Water heating gains (Table 5)	68.6239	66.5920	62.3774	56.6498	52.9305	47.6954	43.2484	48.9491	50.9766	56.9044	63.5983	66.6044	(72)
Total internal gains	507.4233	503.4194	484.0228	453.9712	423.3037	395.7167	379.5034	387.1761	404.3856	434.6374	468.2796	493.6375	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d	Gains W	
Northeast				4.8500	11.2829	0.4400		0.0000		0.7700	18.5399 (75)	
Southwest				7.7400	36.7938	0.4400		0.0000		0.7700	96.4849 (79)	

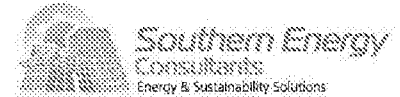
Solar gains	115.0248	202.0880	292.8629	390.2887	462.1812	469.8467	448.4014	393.0835	326.3371	227.7607	138.8947	97.7116 (83)
Total gains	622.4481	705.5074	776.8857	844.2599	885.4848	865.5634	827.9048	780.2597	730.7227	662.3980	607.1743	591.3491 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	47.1990	47.3221	47.4435	48.0217	48.1315	48.6491	48.6491	48.7462	48.4484	48.1315	47.9100	47.6805
alpha	4.1466	4.1548	4.1629	4.2014	4.2088	4.2433	4.2433	4.2497	4.2299	4.2088	4.1940	4.1787
util living area	0.9843	0.9726	0.9479	0.8879	0.7729	0.6022	0.4511	0.4952	0.7222	0.9119	0.9726	0.9871 (86)
MIT	19.7154	19.9059	20.1920	20.5410	20.8088	20.9509	20.9885	20.9831	20.8931	20.5492	20.0720	19.6787 (87)
Th 2	19.8619	19.8646	19.8671	19.8792	19.8814	19.8920	19.8920	19.8939	19.8879	19.8814	19.8769	19.8721 (88)
util rest of house	0.9799	0.9652	0.9335	0.8572	0.7144	0.5124	0.3421	0.3830	0.6375	0.8808	0.9638	0.9835 (89)
MIT 2	18.1922	18.4676	18.8756	19.3628	19.7008	19.8594	19.8876	19.8868	19.8064	19.3876	18.7185	18.1464 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	18.5098	18.7675	19.1501	19.6085	19.9318	20.0870	20.1171	20.1154	20.0330	19.6298	19.0007	18.4659 (91)
Temperature adjustment	-0.1500											
adjusted MIT	18.3598	18.6175	19.0001	19.4585	19.7818	19.9370	19.9671	19.9654	19.8830	19.4798	18.8507	18.3159 (93)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9718	0.9542	0.9194	0.8435	0.7087	0.5162	0.3497	0.3905	0.6371	0.8668	0.9528	0.9763	(94)
Useful gains	604.8814	673.1814	714.2843	712.1323	627.5005	446.8433	289.5236	304.7248	465.5250	574.1960	578.4950	577.3361	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1255.8571	1222.0920	1110.7871	926.9524	707.9001	462.5031	291.7955	308.3605	503.2301	777.8024	1034.0286	1248.1335	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	484.3259	368.8679	294.9981	154.6704	59.8172	0.0000	0.0000	0.0000	0.0000	151.4832	327.9842	499.0733	(98)
Space heating												2341.2203	(98)
Space heating per m2												33.3697	(99)
												(98) / (4) =	

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													2586.9838 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	484.3259	368.8679	294.9981	154.6704	59.8172	0.0000	0.0000	0.0000	0.0000	151.4832	327.9842	499.0733	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	535.1668	407.5889	325.9647	170.9066	66.0964	0.0000	0.0000	0.0000	0.0000	167.3848	362.4135	551.4622	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	133.1915	97.9290	75.2578	35.1662	9.6475	0.0000	0.0000	17.8377	39.2165	79.9137	112.7935	132.5628	(64)
Efficiency of water heater	89.7901	89.8094	89.8307	89.8896	90.0416	87.3000	87.3000	87.3000	87.3000	89.3687	89.6590	89.8091	(216)
(217)m													(217)
Fuel for water heating, kWh/month	148.3365	109.0409	83.7774	39.1215	10.7145	0.0000	0.0000	20.4326	44.9215	89.4203	125.8028	147.6051	(219)
Water heating fuel used												819.1732	(219)
Annual totals kWh/year													
Space heating fuel - main system													2586.9838 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans:													
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
pump for solar water heating													50.0000 (230g)
Total electricity for the above, kWh/year													125.0000 (231)
Electricity for lighting (calculated in Appendix L)													318.0210 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
Total delivered energy for all uses													3849.1780 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost f/year	
Space heating - main system 1	2586.9838	3.4800	90.0270	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	819.1732	3.4800	28.5072	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	318.0210	13.1900	41.9470	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	0.0000	13.1900	0.0000	(252)
Total energy cost			296.9687	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.0831 (257)
SAP value		84.8911
SAP rating (Section 12)		85 (258)
SAP band		B

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
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Regs Region: England

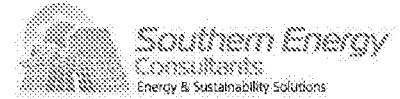
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Space heating - main system 1	2586.9838	0.2160	558.7885 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	819.1732	0.2160	176.9414 (264)
Space and water heating			735.7299 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	318.0210	0.5190	165.0529 (268)
Energy saving/generation technologies			
PV Unit	-2371.6800	0.5190	-1230.9019 (269)
Total kg/year			-265.2441 (272)
CO2 emissions per m2			-3.7800 (273)
EI value			103.0864
EI rating			103 (274)
EI band			A

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
 CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	35.8800 (1b)	x 2.3100 (2b)	= 82.8828 (1b) - (3b)
First floor	34.2800 (1c)	x 2.5100 (2c)	= 86.0428 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.1600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 168.9256 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1776 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4276 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3635 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000 (22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500 (22a)
Adj infilt rate	0.3816	0.3635	0.3635	0.3362	0.3362	0.2998	0.3089	0.2908	0.2998	0.3180	0.3180	0.3453 (22b)
Effective ac	0.5728	0.5660	0.5660	0.5565	0.5565	0.5450	0.5477	0.5423	0.5450	0.5506	0.5506	0.5596 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 2 (Uw = 1.30)			12.5900	1.2357	15.5580		(27)
Opening Type 3			2.0600	1.6000	3.2960		(26a)
Heat Loss Floor 1			35.8800	0.1900	6.8172	75.0000	2691.0000 (28a)
Brick/Render Cavity	82.1100	14.6500	67.4600	0.2500	16.8650	60.0000	4047.6000 (29a)
External Roof 1	34.2800		34.2800	0.1100	3.7708	9.0000	308.5200 (30)
Porch Roof	1.9500		1.9500	0.1100	0.2145	9.0000	17.5500 (30)
Total net area of external elements Aum (A, m ²)			154.2200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.5215		(33)
Party Wall 1			37.5200	0.0000	0.0000	110.0000	4127.2000 (32)
Internal Wall 1			126.7100			9.0000	1140.3900 (32c)
Internal Wall 2			21.4800			75.0000	1611.0000 (32c)
Internal Floor 1			34.2800			18.0000	617.0400 (32d)
Internal Ceiling 1			34.2800			18.0000	617.0400 (32e)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =				15177.3400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							216.3247 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.9427 (36)
Total fabric heat loss			(33) + (36) =				55.4642 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	31.9321	31.5547	31.5547	31.0231	31.0231	30.3788	30.5329	30.2292	30.3788	30.6917	30.6917	31.1957 (38)
Heat transfer coeff	87.3963	87.0189	87.0189	86.4873	86.4873	85.8430	85.9971	85.6934	85.8430	86.1559	86.1559	86.6599 (39)
Average = Sum(39)m / 12 =												86.3964 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2457	1.2403	1.2403	1.2327	1.2327	1.2235	1.2257	1.2214	1.2235	1.2280	1.2280	1.2352 (40)
HLP (average)												1.2314 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2500 (42)
Average daily hot water use (litres/day)												87.6376 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	96.4013	92.8958	89.3903	85.8848	82.3793	78.8738	78.8738	82.3793	85.8848	89.3903	92.8958	96.4013 (44)
Energy conte	142.9604	125.0341	129.0240	112.4862	107.9332	93.1381	86.3062	99.0376	100.2204	116.7972	127.4933	138.4495 (45)

Regs Region: England

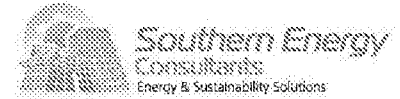
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)	Total = Sum(45)m =											1378.8803 (45)
Distribution loss (46)m = 0.15 x (45)m												
	21.4441	18.7551	19.3536	16.8729	16.1900	13.9707	12.9459	14.8556	15.0331	17.5196	19.1240	20.7674 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.0873	12.7040	14.0334	13.5447	13.9700	13.4891	13.9199	13.9524	13.5194	14.0071	13.5970	14.0769 (61)
Total heat required for water heating calculated for each month	157.0477	137.7381	143.0573	126.0309	121.9032	106.6273	100.2261	112.9900	113.7398	130.8044	141.0904	152.5264 (62)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m2												1140.0998 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												1915.3676 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.3891 (H8)
Utilisation factor												0.5132 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												87.6376 (H14)
Volume ratio Veff/V												0.8558 (H15)
Solar storage volume factor												0.9689 (H16)
Solar input												-837.3990 (H17)
Solar input	-25.7747	-38.7394	-65.2420	-90.1844	-108.6123	-114.3098	-111.5650	-99.6282	-77.7601	-52.8988	-31.3299	-21.3545 (63)
	Solar input (sum of months) = Sum(63)m =											-837.3990 (63)
Output from w/h	131.2730	98.9988	77.8153	35.8465	13.2908	0.0000	0.0000	13.3618	35.9797	77.9056	109.7605	131.1719 (64)
	Total per year (kWh/year) = Sum(64)m =											725.4038 (64)
Heat gains from water heating, kWh/month	51.0562	44.7498	46.4088	40.7878	39.3803	34.3407	32.1768	36.4181	36.7031	42.3369	45.7908	49.5537 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	135.0002	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.0192	39.9856	32.5185	24.6186	18.4027	15.5363	16.7875	21.8211	29.2882	37.1881	43.4040	46.2704	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	295.0302	298.0916	290.3768	273.9528	253.2204	233.7349	220.7174	217.6559	225.3708	241.7948	262.5271	282.0126	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	50.7500	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	-90.0001	(71)
Water heating gains (Table 5)	68.6239	66.5920	62.3774	56.6498	52.9305	47.6954	43.2484	48.9491	50.9766	56.9044	63.5983	66.6044	(72)
Total internal gains	507.4233	503.4194	484.0228	453.9712	423.3037	395.7167	379.5034	387.1761	404.3856	434.6374	468.2796	493.6375	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b		FF Specific data or Table 6c	Access factor Table 6d		Gains W	
Northeast				4.8500	12.9236	0.4400		0.0000	0.7700		21.2357 (75)	
Southwest				7.7400	40.4699	0.4400		0.0000	0.7700		106.1247 (79)	

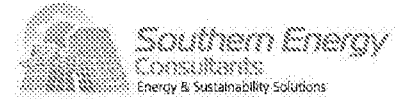
Solar gains	127.3605	201.7204	289.9885	400.5389	463.9468	505.4625	476.8944	426.2442	351.0490	243.0688	157.6226	107.1084 (83)
Total gains	634.7838	705.1398	774.0113	854.5101	887.2505	901.1792	856.3978	813.4204	755.4347	677.7062	625.9021	600.7459 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	48.2392	48.4484	48.4484	48.7462	48.7462	49.1121	49.0240	49.1978	49.1121	48.9337	48.9337	48.6491
alpha	4.2159	4.2299	4.2299	4.2497	4.2497	4.2741	4.2683	4.2799	4.2741	4.2622	4.2622	4.2433
util living area	0.9797	0.9675	0.9356	0.8535	0.6980	0.4656	0.3098	0.3350	0.6165	0.8745	0.9613	0.9831 (86)
MIT	19.8719	20.0323	20.3244	20.6601	20.8930	20.9858	20.9981	20.9974	20.9526	20.6797	20.2356	19.8407 (87)
Th 2	19.8836	19.8879	19.8879	19.8939	19.8939	19.9012	19.8995	19.9029	19.9012	19.8977	19.8977	19.8920 (88)
util rest of house	0.9739	0.9586	0.9175	0.8141	0.6255	0.3682	0.2006	0.2213	0.5165	0.8310	0.9486	0.9783 (89)
MIT 2	18.4335	18.6654	19.0767	19.5299	19.8050	19.8946	19.8992	19.9024	19.8723	19.5699	18.9661	18.3948 (90)
Living area fraction	fLA = Living area / (4) =											0.2085 (91)
MIT	18.7334	18.9504	19.3368	19.7656	20.0318	20.1221	20.1283	20.1308	20.0976	19.8013	19.2308	18.6963 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.5834	18.8004	19.1868	19.6156	19.8818	19.9721	19.9783	19.9808	19.9476	19.6513	19.0808	18.5463 (93)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9646	0.9468	0.9032	0.8027	0.6247	0.3747	0.2085	0.2294	0.5210	0.8193	0.9361	0.9699	(94)
Useful gains	612.3176	667.6581	699.0970	685.8765	554.2466	337.6300	178.5534	186.6118	393.5822	555.2271	585.9155	582.6866	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1178.3992	1148.6860	1025.6776	840.2766	595.1912	340.9781	178.7296	186.8777	407.5441	693.6684	954.6754	1165.2536	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	421.1647	323.2508	242.9759	111.1680	30.4628	0.0000	0.0000	0.0000	0.0000	103.0003	265.5071	433.4298	(98)
Space heating													
												1930.9595	(98)
Space heating per m2											(98) / (4) =	27.5222	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													2133.6569 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	421.1647	323.2508	242.9759	111.1680	30.4628	0.0000	0.0000	0.0000	0.0000	103.0003	265.5071	433.4298	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	465.3753	357.1832	268.4817	122.8376	33.6606	0.0000	0.0000	0.0000	0.0000	113.8125	293.3780	478.9280	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	131.2730	98.9988	77.8153	35.8465	13.2908	0.0000	0.0000	13.3618	35.9797	77.9056	109.7605	131.1719	(64)
Efficiency of water heater	89.7185	89.7289	89.7024	89.6983	89.5034	87.3000	87.3000	87.3000	87.3000	89.0936	89.5400	89.7358	(216)
Fuel for water heating, kWh/month	146.3165	110.3310	86.7483	39.9634	14.8495	0.0000	0.0000	15.3056	41.2138	87.4424	122.5826	146.1756	(219)
Water heating fuel used												810.9287	(219)
Annual totals kWh/year													
Space heating fuel - main system													2133.6569 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans:													
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
pump for solar water heating													50.0000 (230g)
Total electricity for the above, kWh/year													125.0000 (231)
Electricity for lighting (calculated in Appendix L)													318.0210 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
Total delivered energy for all uses													3387.6066 (238)

10a. Fuel costs - using BEDF prices (470)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost f/year	
Space heating - main system 1	2133.6569	3.8700	82.5725 (240)	
Space heating - secondary	0.0000	0.0000	0.0000 (242)	
Water heating (other fuel)	810.9287	3.8700	31.3829 (247)	
Pumps and fans for heating	75.0000	18.9000	14.1750 (249)	
Pump for solar water heating	50.0000	18.9000	9.4500 (249)	
Energy for lighting	318.0210	18.9000	60.1060 (250)	
Additional standing charges			93.0000 (251)	
Energy saving/generation technologies				
PV Unit	0.0000	18.9000	0.0000 (252)	
Total energy cost			290.6864 (255)	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2133.6569	0.2160	460.8699 (261)	
Space heating - secondary	0.0000	0.0000	0.0000 (263)	
Water heating (other fuel)	810.9287	0.2160	175.1606 (264)	
Space and water heating			636.0305 (265)	
Pumps and fans	125.0000	0.5190	64.8750 (267)	
Energy for lighting	318.0210	0.5190	165.0529 (268)	
Energy saving/generation technologies				
PV Unit	-2371.6800	0.5190	-1230.9019 (269)	
Total kg/year			-364.9435 (272)	

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	2133.6569	1.2200	2603.0614 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	810.9287	1.2200	989.3330 (264)
Space and water heating			3592.3944 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	318.0210	3.0700	976.3245 (268)
Energy saving/generation technologies			
PV Unit	-2371.6800	3.0700	-7281.0576 (269)
Primary energy kWh/year			-2328.5887 (272)
Primary energy kWh/m2/year			-33.1897 (273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	216.3 (calculated from construction elements)
Night ventilation	Yes
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	222.98 (P1)
Transmission heat loss coefficient	55.46 (37)
Summer heat loss coefficient	278.45 (P2)

Overhangs	Ratio	Z_overhangs	Overhang type
Orientation			
North East	0.000	1.000	None
South West	0.000	1.000	None

Solar shading	Z blinds	Solar access	Z overhangs	Z summer
Orientation				
North East	1.000	0.90	1.000	0.900 (P8)
South West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	4.8500	98.8453	0.4400	0.0000	0.9000	189.8422
South West	7.7400	119.9223	0.4400	0.0000	0.9000	367.5668
total:						557.4090

	Jun	Jul	Aug	
Solar gains	591	557	498	(P4)
Internal gains	393	377	384	
Total summer gains	984	934	882	(P5)
Summer gain/loss ratio	3.53	3.35	3.17	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 216.3)	0.49	0.49	0.49	
Threshold temperature	20.02	21.74	21.45	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			